

NOTE ON THE OCCURRENCE OF A SWARM OF *SALPA CYLINDRICA* CUVIER (TUNICATA: SALPIDAE) IN SARDINERA LAGOON, PUERTO RICO

Takasi Tokioka and P. B. Bhavanarayana

Abstract.—The occurrence of a dense swarm of solitary individuals of *Salpa cylindrica* Cuvier in Puerto Rican waters is reported, and evidence is presented that solitary individuals of *Iasis zonaria* (Pallas) may produce similar swarms in Japanese waters. Morphological details of the Puerto Rican specimens are described and illustrations provided.

A sample from a swarm of a pelagic tunicate observed by Mr. T. A. Wiewandt during the first week of July 1974 in Sardinera Lagoon, Isla de Mona, Puerto Rico, was forwarded to the authors for identification by Dr. F. M. Bayer of the National Museum of Natural History, Smithsonian Institution. The specimens were solitary individuals of the tropical salp, *Salpa cylindrica* Cuvier, 1804. According to notes of the observer, these salps occurred in a swarm of thousands (millions?) of individuals that looked in life like clear pulsating cylinders each with a solid blue sphere at one end; further, a similar swarm had been seen, also in brief abundance, at Playa de Pajaros two years before (1972). The notes seem to imply that the entire swarm, like the sample examined, was composed solely of solitary individuals of *S. cylindrica*. This is very interesting, because swarms of salps are generally composed of a larger number of aggregate forms and a much smaller number of solitary forms. This proportion is quite natural, since asexual propagation by budding of the stolon in the solitary forms is incomparably greater than the sexual propagation by placental embryos in the aggregate forms. Thus, the formation of dense swarms by only the solitary forms must be rather rare, though not impossible. However, one of the authors has found that the stomachs of a number of mackerels from Japanese waters were full solely of the solitary forms of *Iasis zonaria* (Pallas). As the aggregate form of that salp is nearly as large as the solitary form, no feeding selection is possible by the fish. This observation is evidence for the formation of swarms in *Iasis* consisting only of solitary forms.

Occurrences of swarms of only solitary forms in salps indicate both well synchronized breeding and some stability of the water masses inhabited by such swarms, although they might be formed by accumulation on the boundaries between water masses. If the latter is the case, it follows that some evidence of morphological change leading toward speciation among popu-

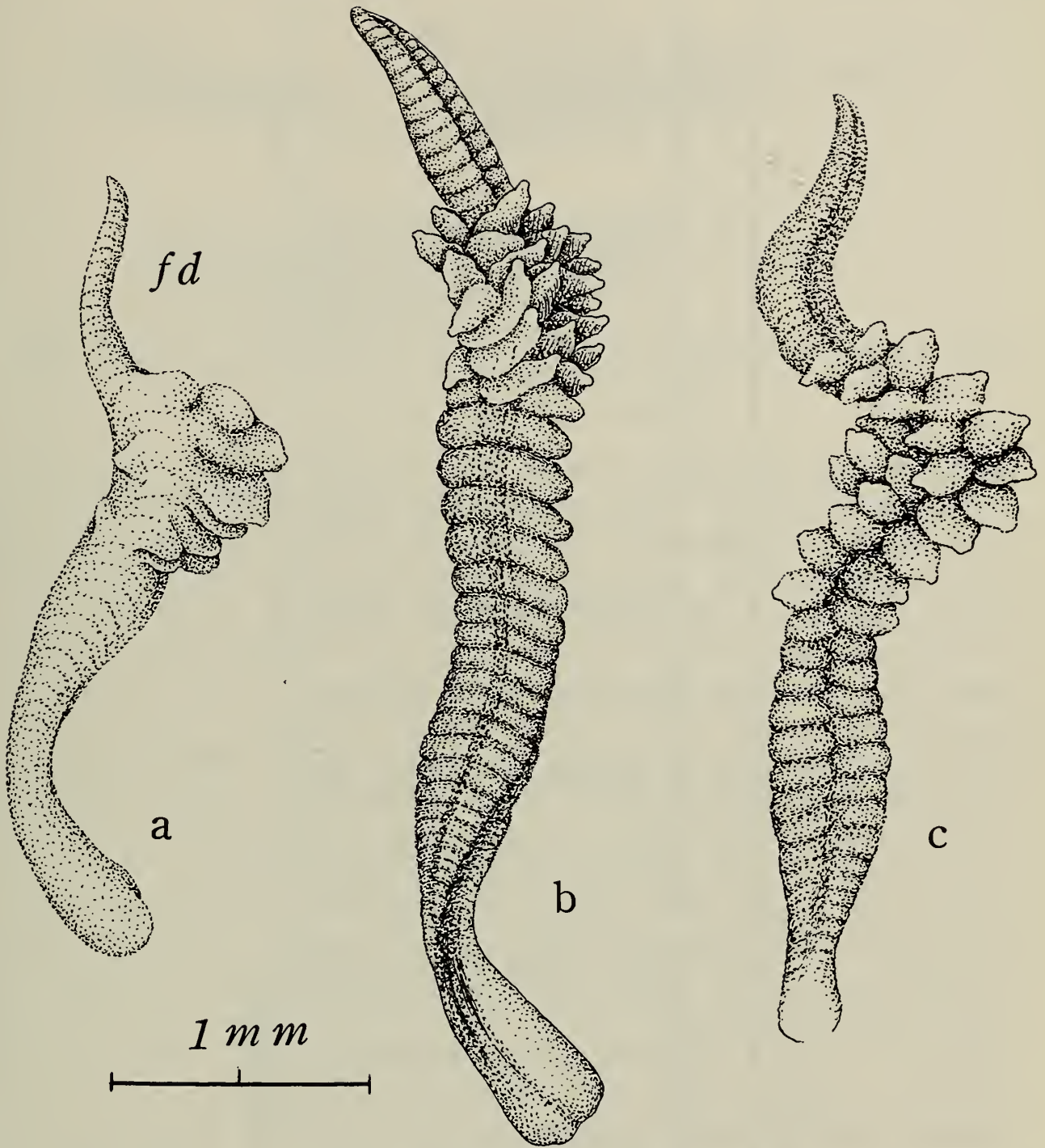


Fig. 1. Stolon with narrow distal part (fd). a, 18 mm long specimen; b, 23 mm long specimen, c, 16 mm long specimen.

lations of those salps separated from one another in different water masses may be expected. In anticipation of this, some detailed observations on the specimens subjected to examination, especially on the numbers of muscular bands in the respective body muscles as recorded in Table 1, were made to help future studies.

In all of the 14 specimens examined, from 16 mm to about 24 mm in length, the nucleus is situated between body muscle VIII and cloacal muscle

Table 1. Distribution of muscular bands in body muscles.

Specimen No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Body length	16 mm	17 mm	18 mm	19 mm	19 mm	20 mm	20 mm	20 mm	21 mm	21 mm	22 mm	23 mm	24 mm	20 mm+
Body muscle I	21	24	24	20	18	18	23	21	18	23	19	21	22	22
II	16	18	15*	18	20	16	18	16	18	23	18	21	23	19
III	17	20	24*	20	22*	23	20	17	24	17	21	21	23*	19*
IV	22	23*	21*	23	20*	20	19	23	20*	21	18*	24	26*	24*
V	21	23	22	22	20	23	24	19	22	26	22	24	26	25
VI	16	22	14	20	19	21	22	19	20	24	18	21	23	21
VII	21	23	16	20	19	25	19	23	18	23	23	23	28	23
VIII	15	22	18	22	15	20	22	24	17	22	18	24	25	24
Cloacal muscle I	15	19	17	14	14	17	17	16	16	19	18	18	19	—
Total	164	194	171	179	167	183	184	178	173	198	175	197	215	177+

* Body muscles I-IV are generally in contact middorsally with one another. In some specimens, however, some of these muscles, shown by an asterisk, approach the others but remain separated.

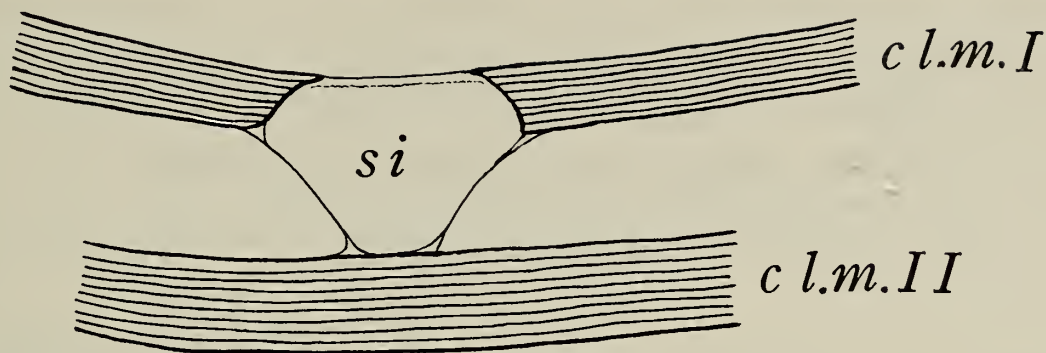


Fig. 2. Sinus (si) connecting ends of posterior branch of cloacal muscle I (cl.m. I) to mid-ventral part of cloacal muscle II (cl.m. II), 23 mm long specimen.

I (defined by some specialists as body muscle IX). In all the specimens, the stolon generally reaches anteriorly to body muscle VI; in some specimens the distal part of the stolon is narrower than the subdistal part because the stolon-individuals are less developed in the former than in the latter (Fig. 1), and this narrow distal part may extend anteriorly to body muscle V or turn back to the middle of the space between body muscles VI and VII. It is not known, however, whether or not such a distal structure of the stolon is usual, at least in young (or small) solitary forms of the species from the sea area concerned. Cloacal muscle I is divided ventrally into anterior and posterior branches. The anterior branch is mid-ventrally divided clearly, with each end terminating near the posterior end of the stomach, and consists of 8 to 13 muscular bands; while the posterior branch consists of 5 to 9 muscular bands and is divided mid-ventrally rather indistinctly at a level slightly posterior to the anus, usually with a sinus connecting both ends of the branch to the ventral middle of cloacal muscle II; this shows that the posterior branch might originally be in contact with cloacal muscle II in the mid-ventral line (Fig. 2). Cloacal muscle II consists of 9 to 14 muscular bands, the first atrial sphincter of about 6, the second of about 3, and the third of 2 muscular bands followed by up to 8 fine sphincters each consisting of a single band.

Acknowledgment

Before closing the present short note the authors wish to express their cordial thanks to Dr. Bayer for the opportunity of examining these specimens from the West Indies.

Literature Cited

- *Fagetti Guaita, Elda. 1959. Salpas colectadas frente a las costas central y norte de Chile.—
Rev. Biol. Mar. Valparaiso 9(1-3):201-228, pls. 1-6.

* In these papers, *Salpa cylindrica* is referred to as *Weelia cylindrica*.

- Metcalf, M. M. 1918. The Salpidae: a taxonomic study.—U.S. Nat. Mus. Bull. 100, vol. 2, part 3:3–193, pls. 1–14.
- Sewell, R. B. S. 1953. The pelagic Tunicata.—John Murray Exped. 1933–34. Sci. Rep. 10(1):1–90, 1 pl., 32 figs.
- Thompson, Harold. 1948. Pelagic tunicates of Australia.—Commonwealth Council for Scientific and Industrial Research, Australia, Melbourne. 196 pp., 75 pls.
- *Yount, J. L. 1954. The taxonomy of the Salpidae (Tunicata) of the Central Pacific Ocean.—Pacific Sci. 8:276–330.

(TT) Rinkai 454-3, Shirahama, Wakayama-ken, Japan 649-22; (PBB) Andhra University, Waltair, India.